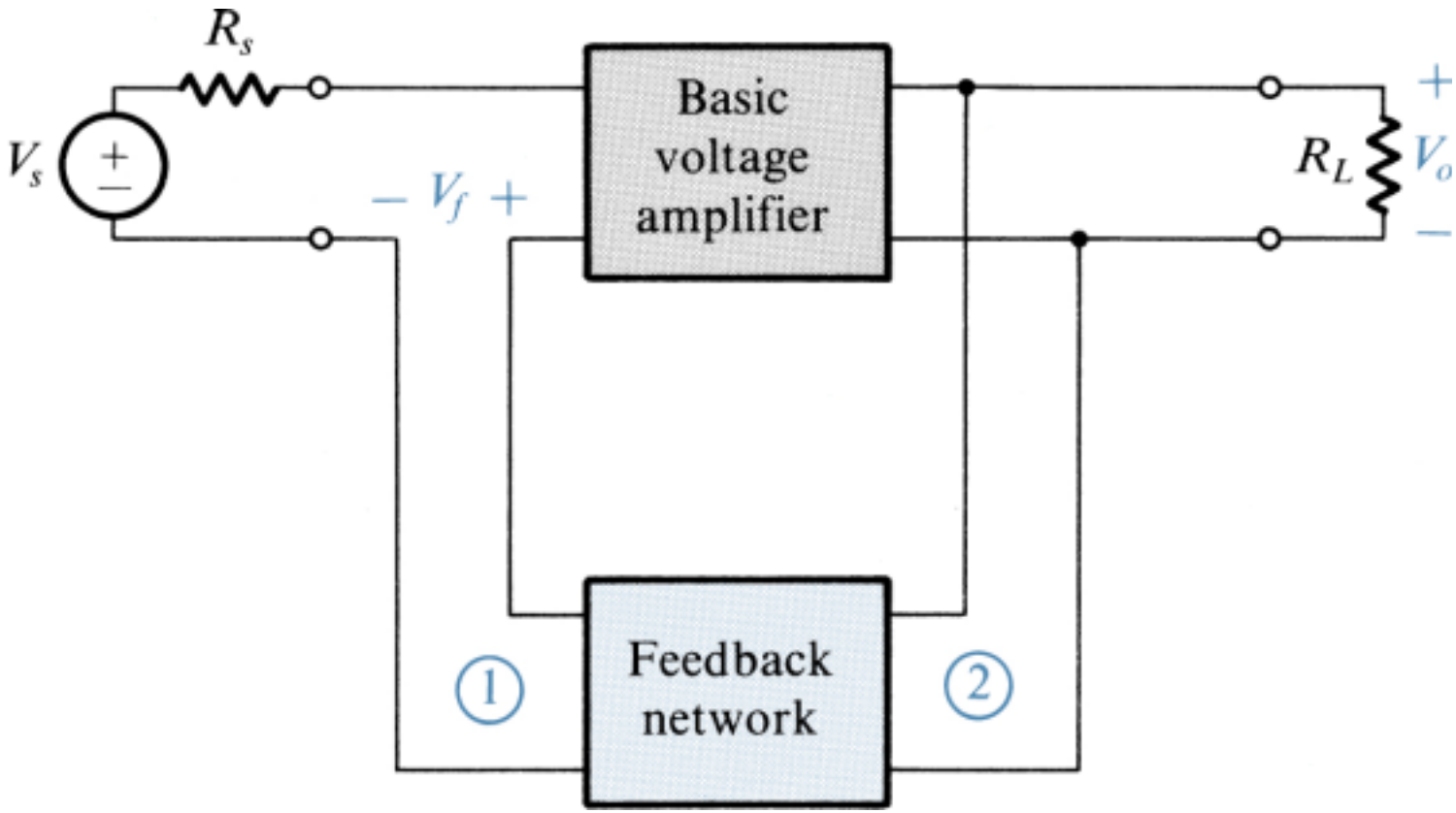
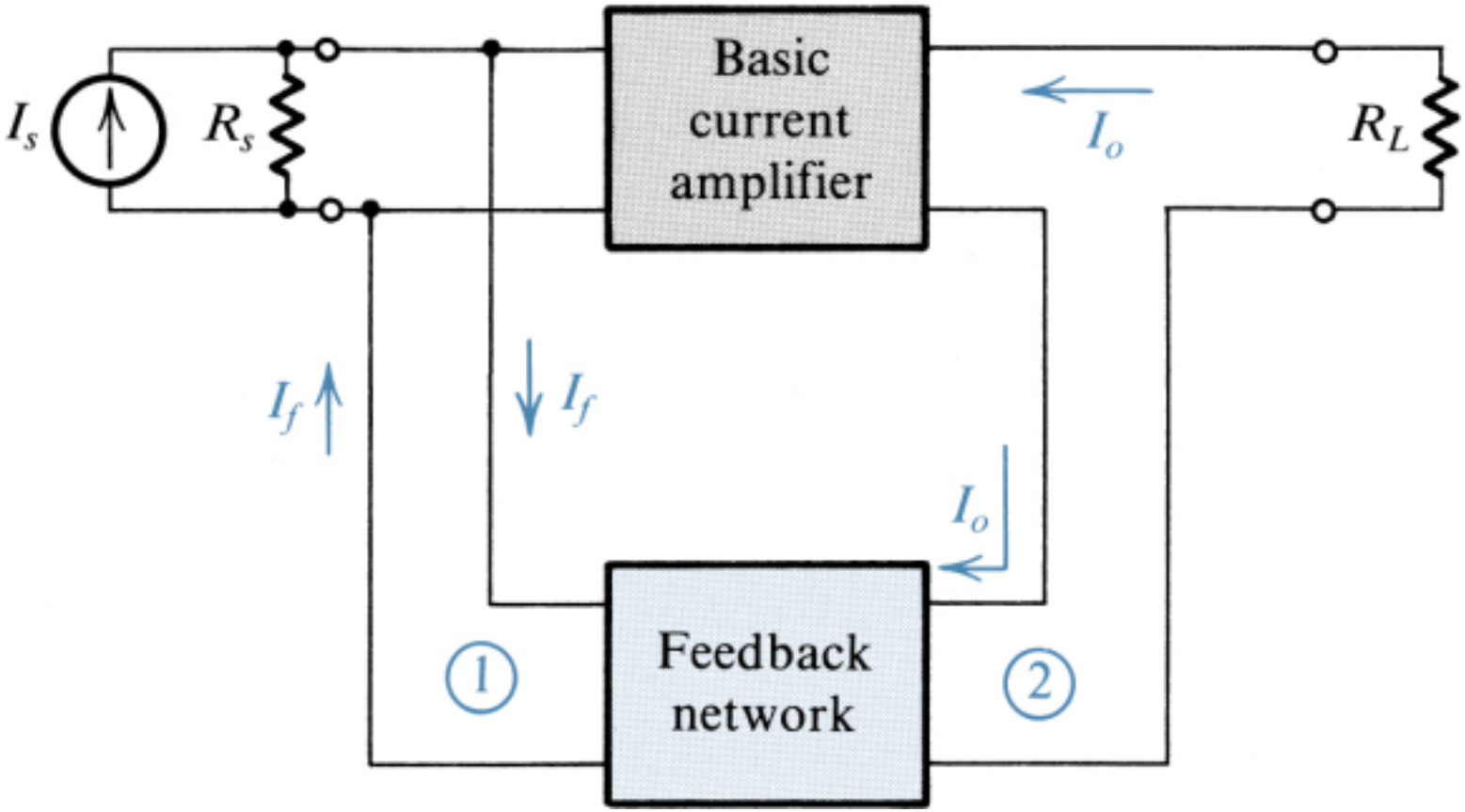
EE-4232

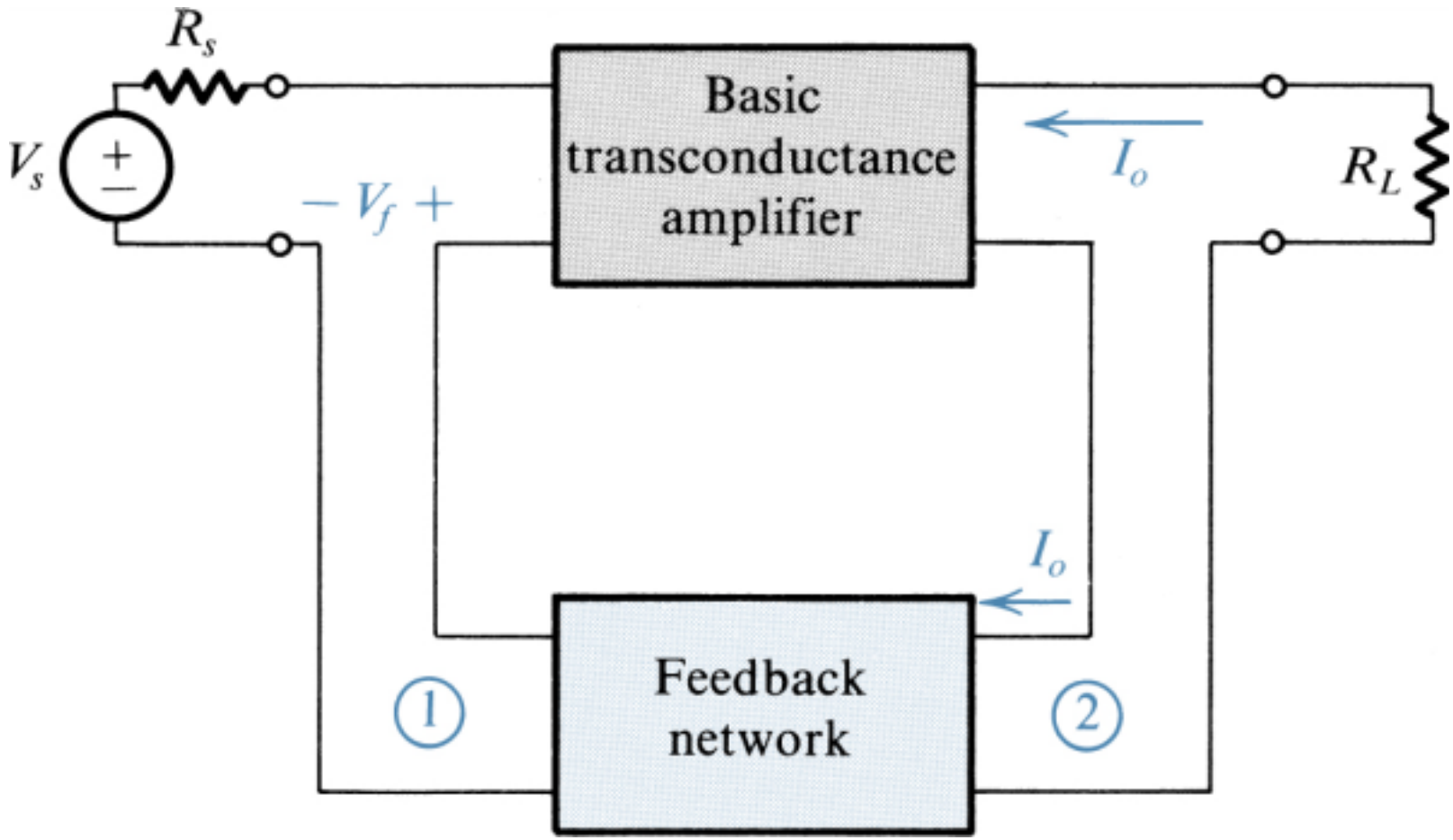
Feedback Topologies



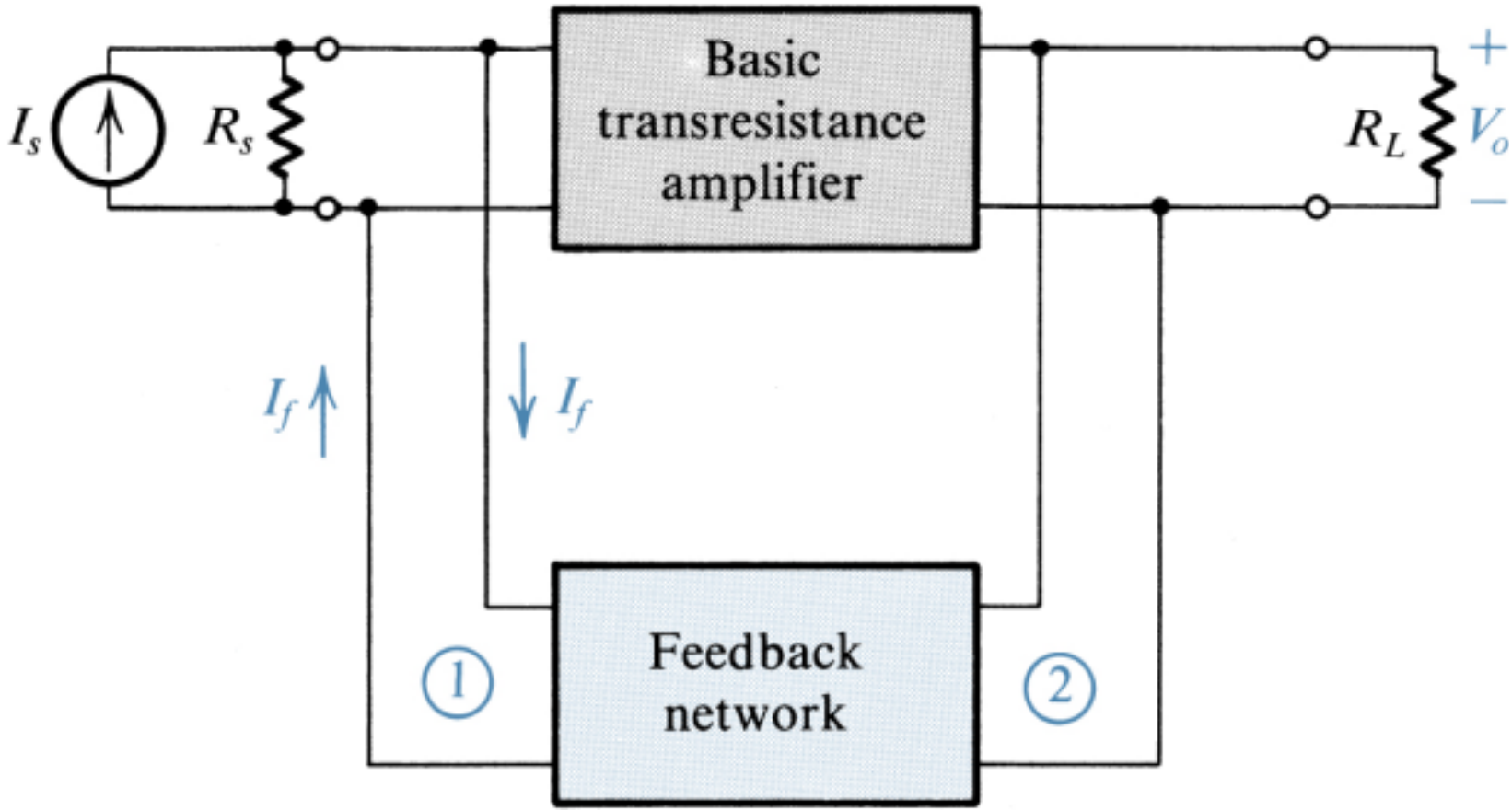
The four basic feedback topologies: voltage-sampling series-mixing (series-shunt) topology



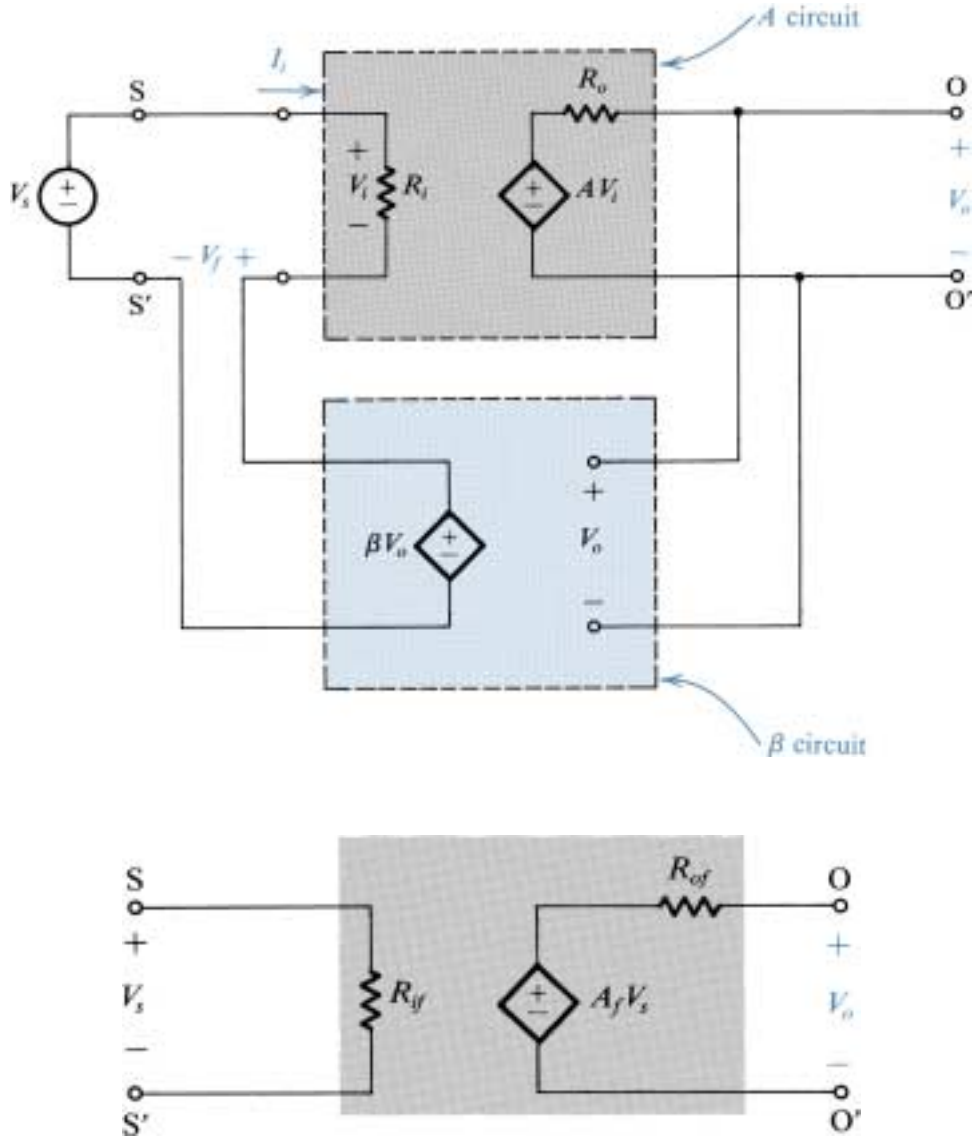
The four basic feedback topologies: current-sampling shunt-mixing (shunt-series) topology



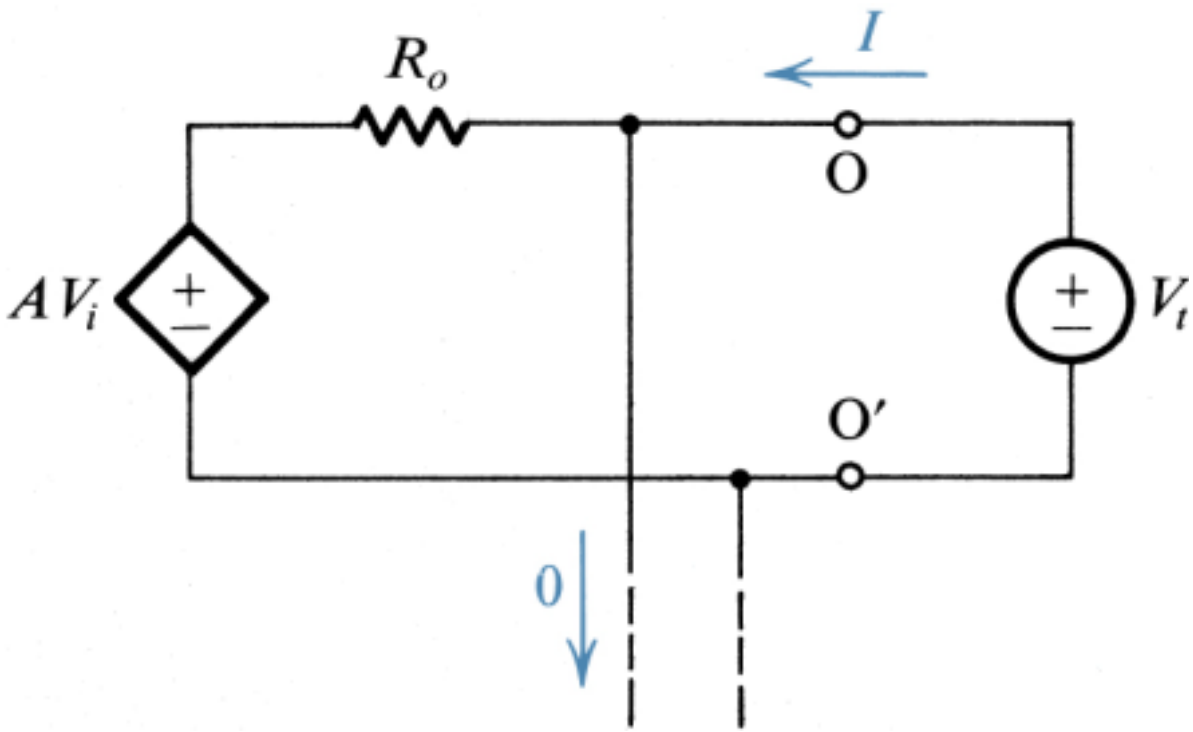
The four basic feedback topologies: current-sampling series-mixing (series-series) topology



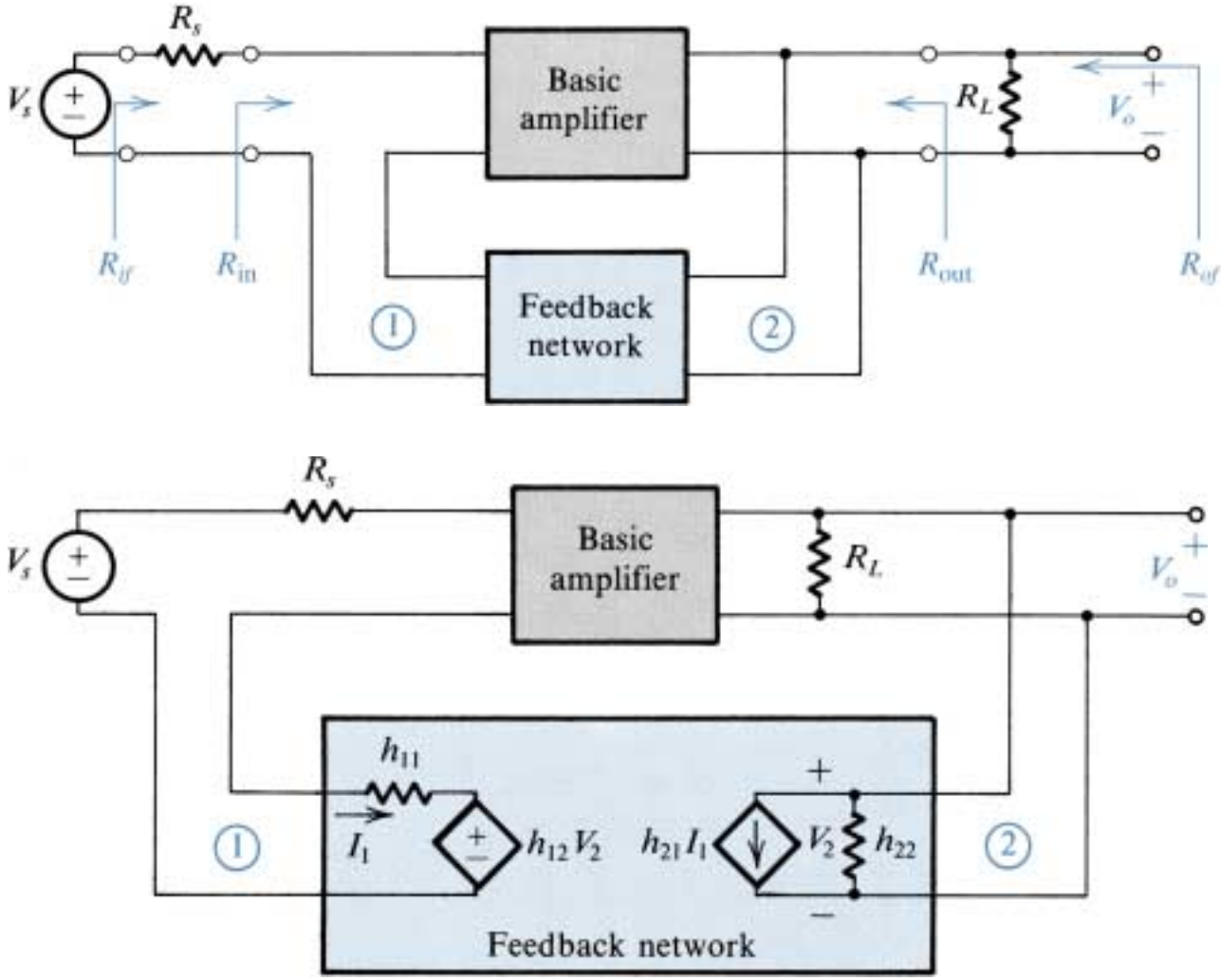
The four basic feedback topologies: voltage-sampling shunt-mixing (shunt-shunt) topology



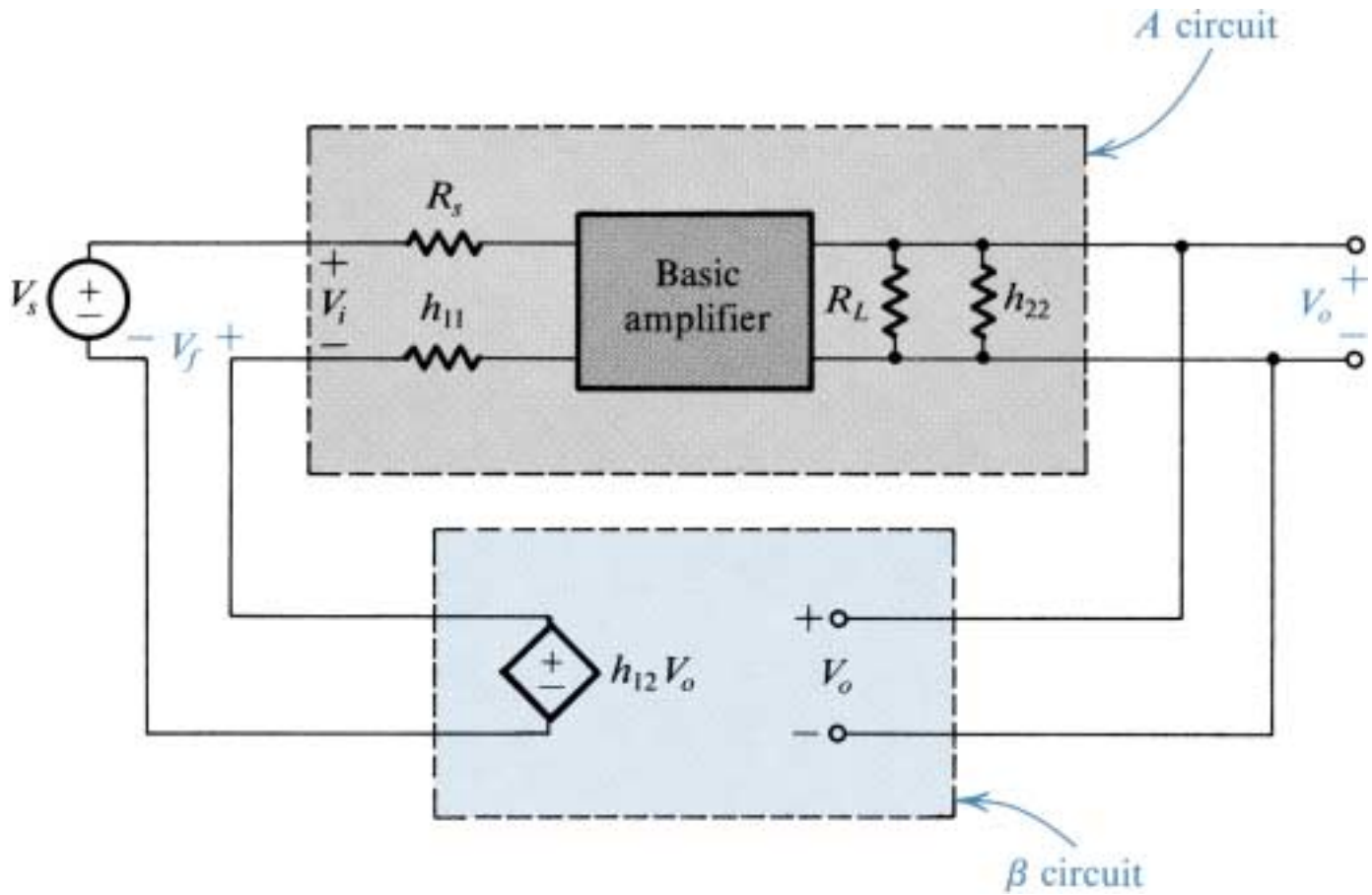
The series-shunt feedback amplifier: (a) ideal structure; (b) equivalent circuit.



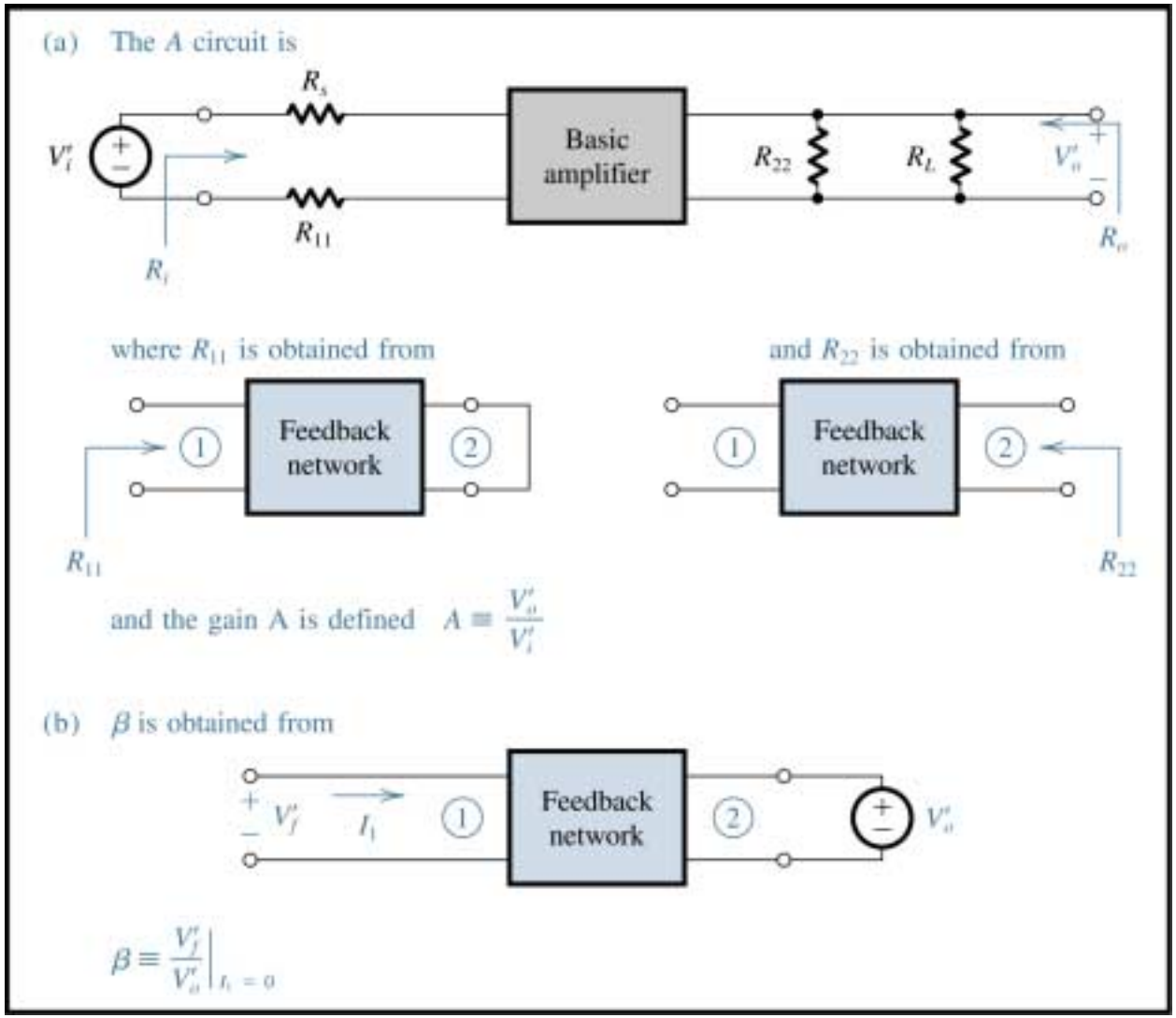
Measuring the output resistance of the feedback amplifier of Fig. (a): $R_{of} \equiv V_t/I$.



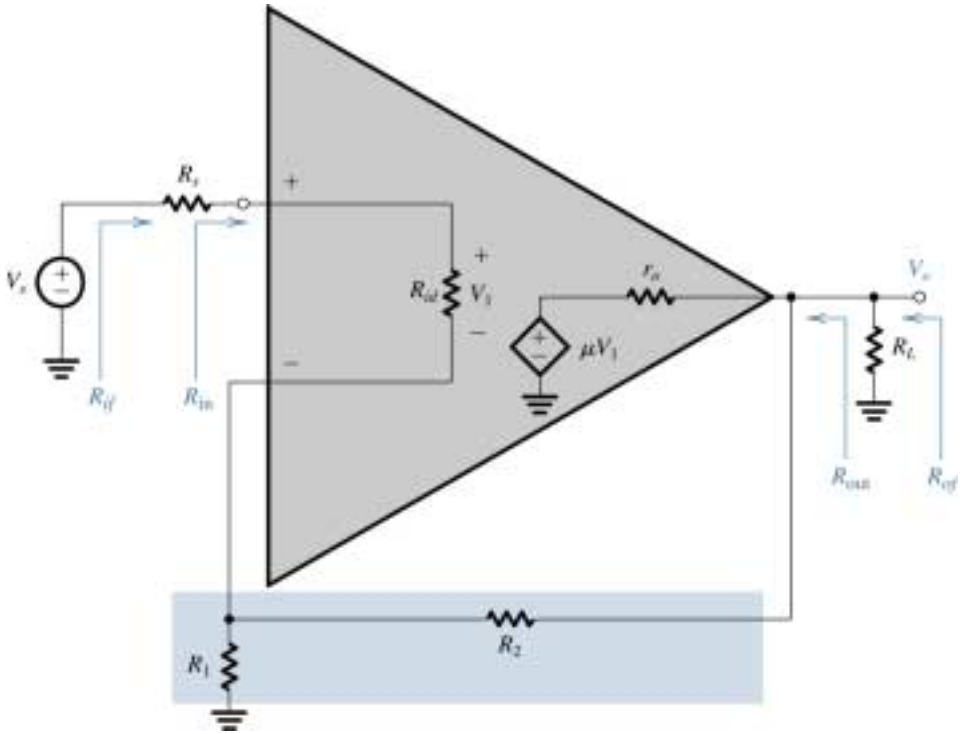
Derivation of the *A* circuit and β circuit for the series-shunt feedback amplifier. (a) Block diagram of a practical series-shunt feedback amplifier. (b) The circuit in (a) with the feedback network represented by its *h* parameters.

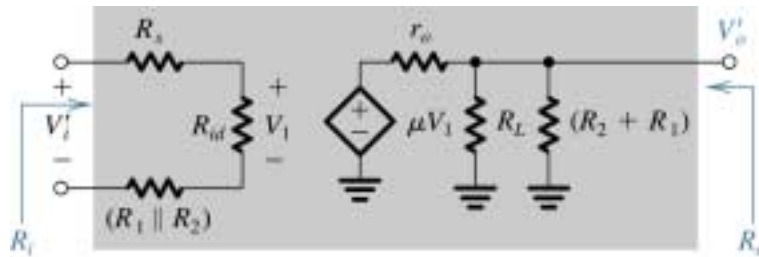


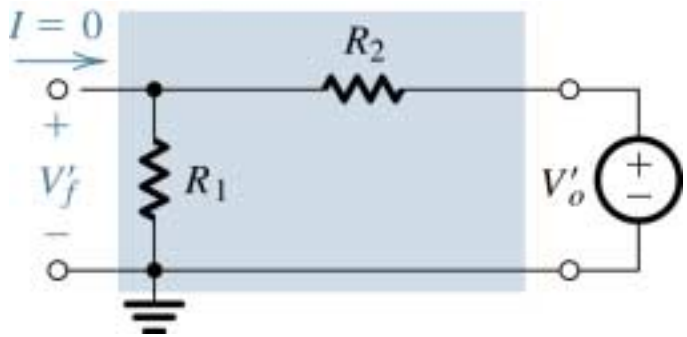
Derivation of the *A* circuit and β circuit for the series-shunt feedback amplifier. (c) The circuit in (b) after neglecting h_{21}.

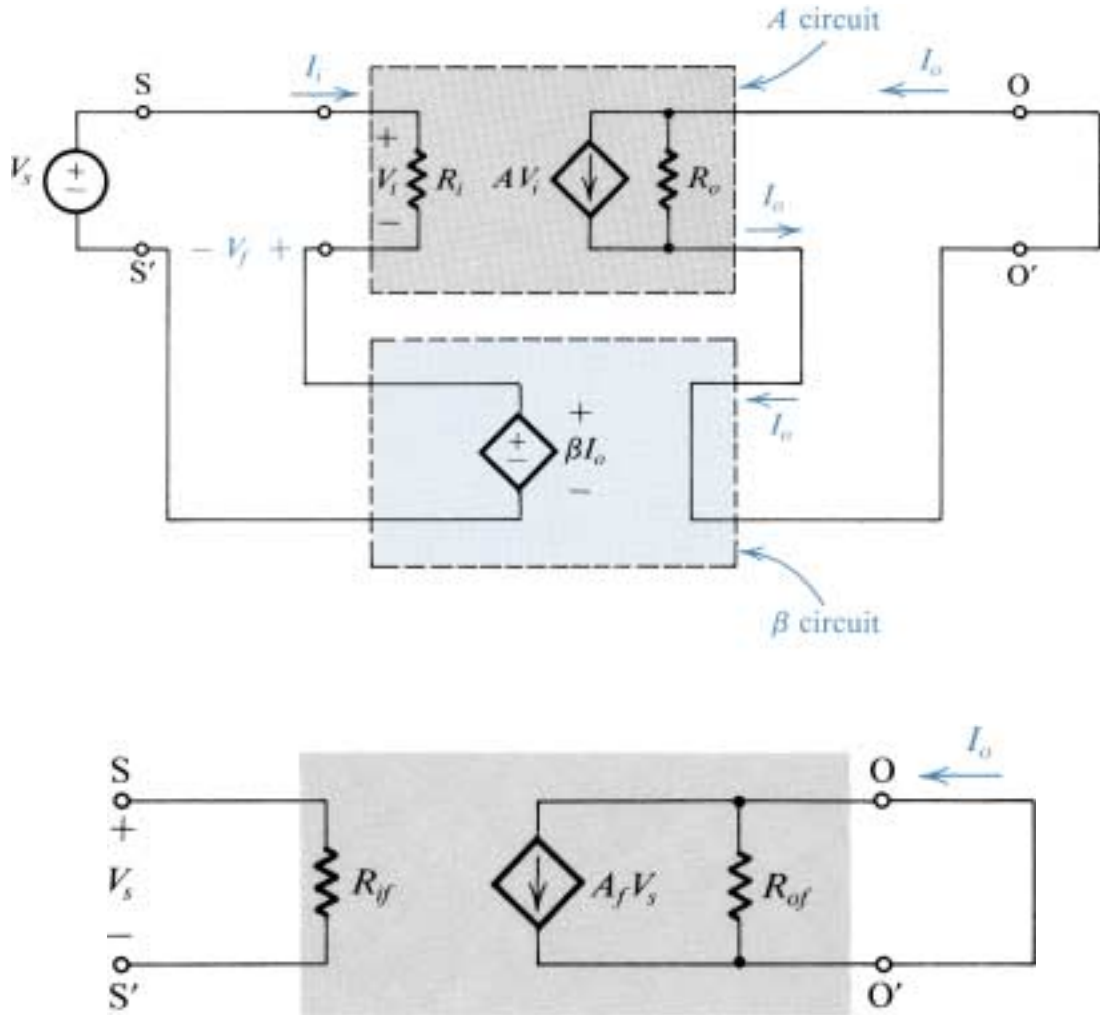


Summary of the rules for finding the *A* circuit and β for the voltage-sampling series-mixing case.

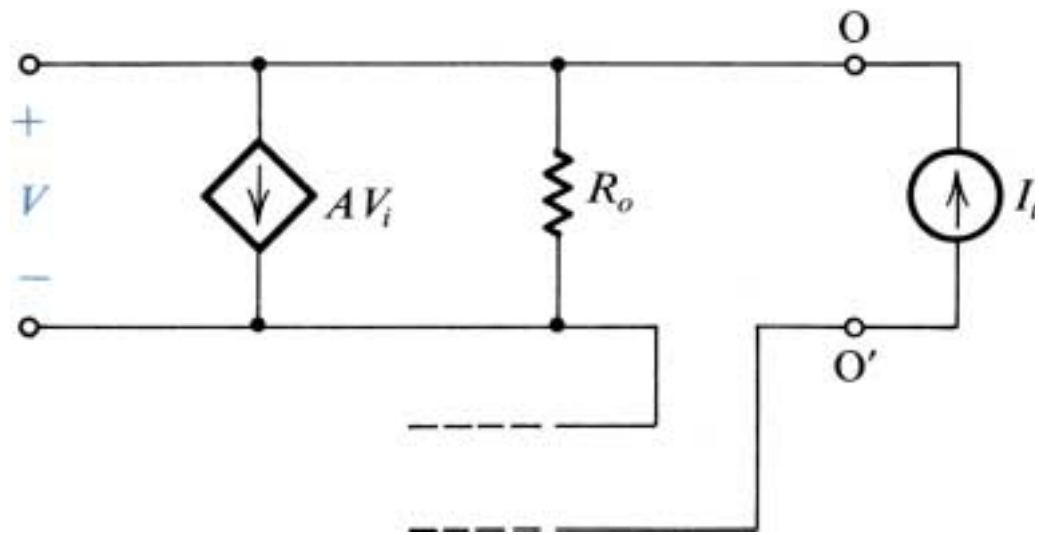

R_s
V_s
R_{if}
R_{in}
R_{id}
V_1
μV_1
r_o
V_o
R_L
R_{out}
R_{of}
R_1
R_2


R_s
V_i'
R_{id}
V_1
$(R_1 \parallel R_2)$
r_o
μV_1
R_L
$(R_2 + R_1)$
V_o'
R_i
R_o

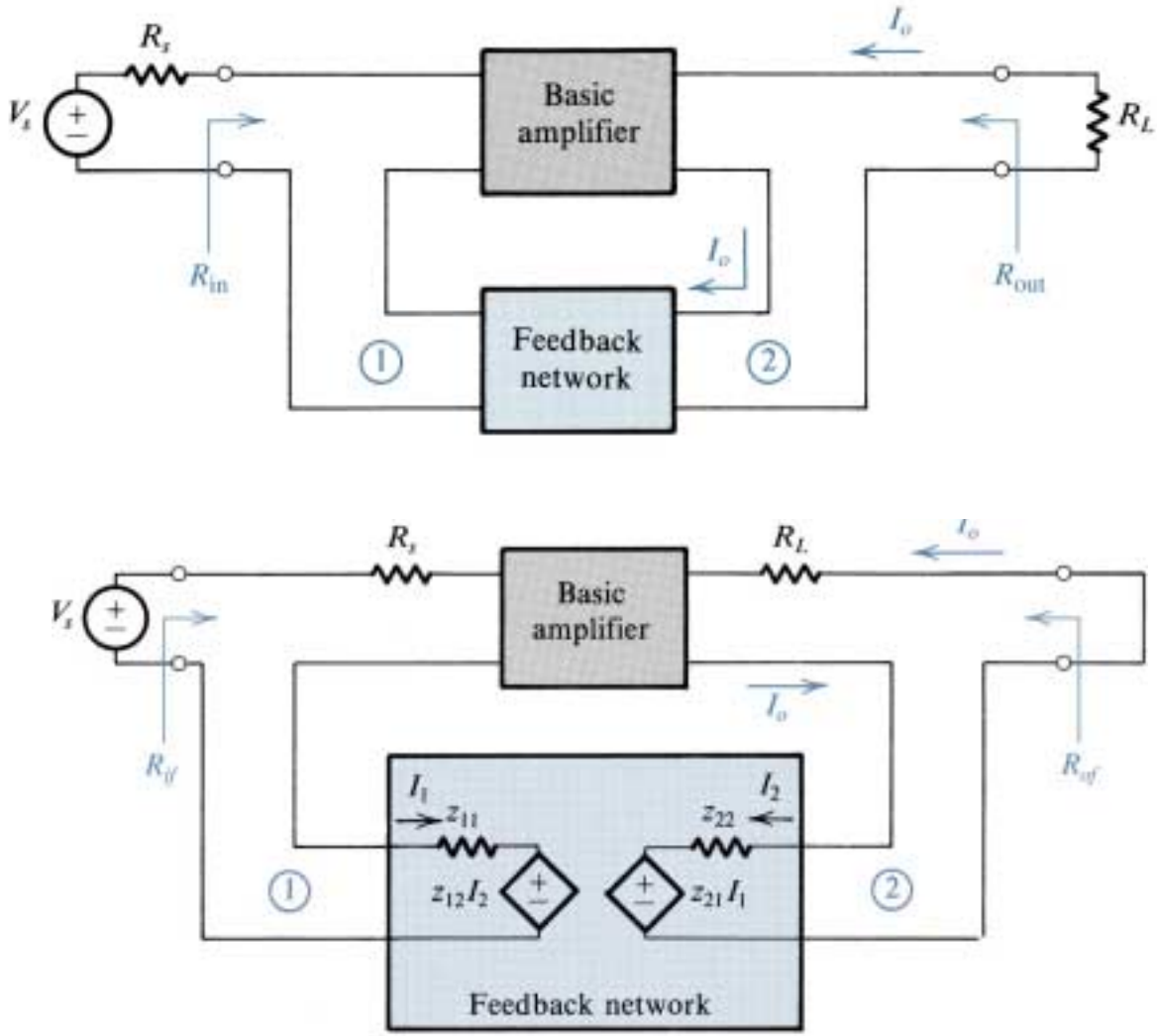

$I = 0$
V_f'
R_1
R_2
V_o'



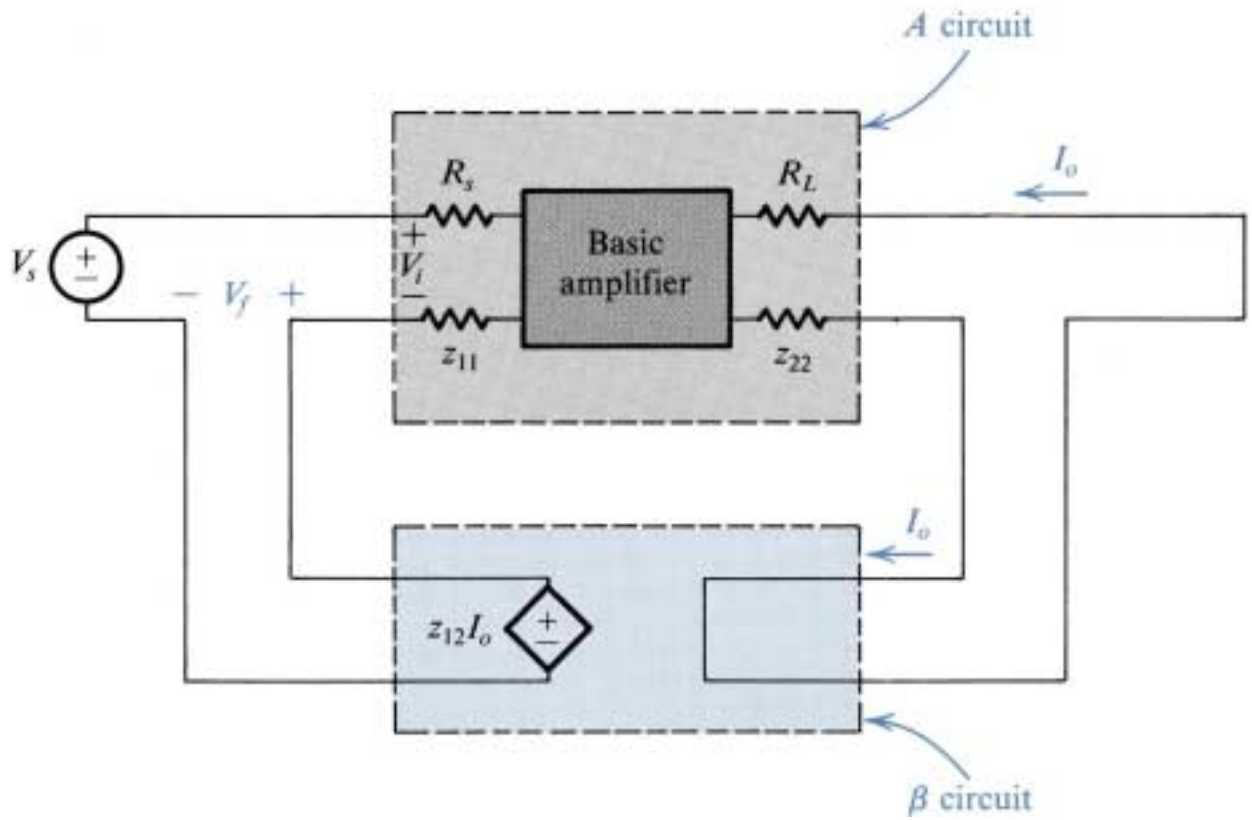
The series-series feedback amplifier: (a) ideal structure; (b) equivalent circuit.



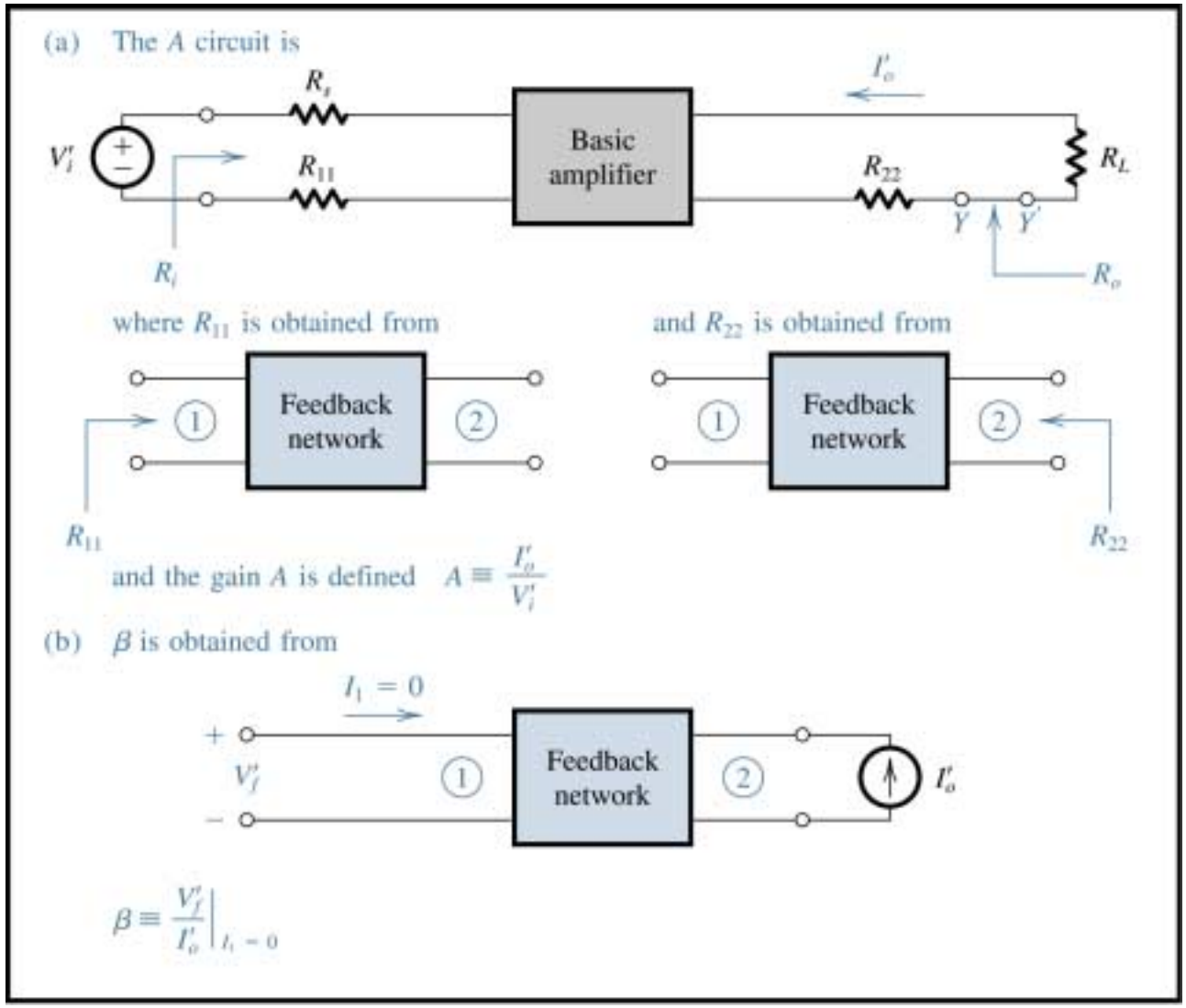
Measuring the output resistance R_{of} of the series-series feedback amplifier.



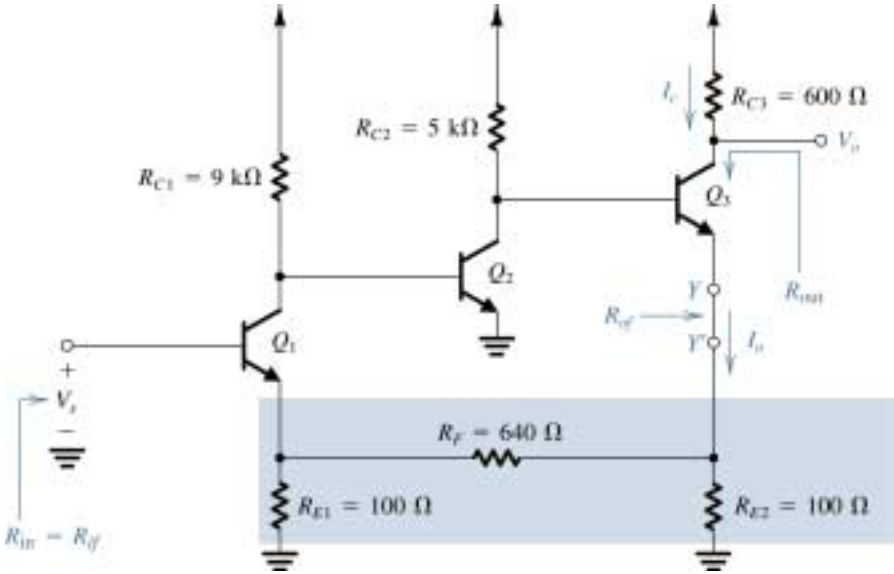
Derivation of the *A* circuit and β circuit for the series-series feedback amplifiers. (a) A series-series feedback amplifier. (b) The circuit of (a) with the feedback network represented by its *z* parameters.

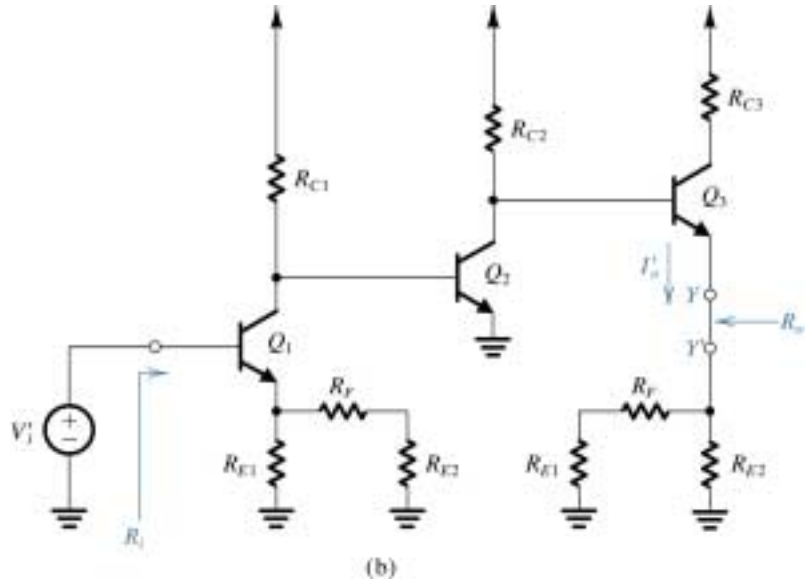


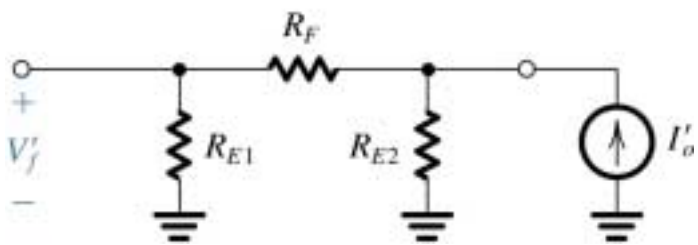
Derivation of the *A* circuit and β circuit for the series-series feedback amplifiers. (c) A redrawing of the circuit in (b) after neglecting z_{21}.

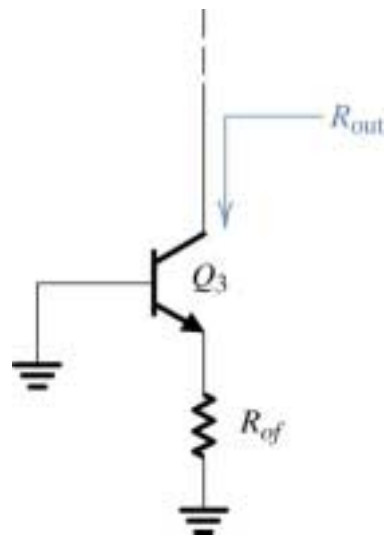


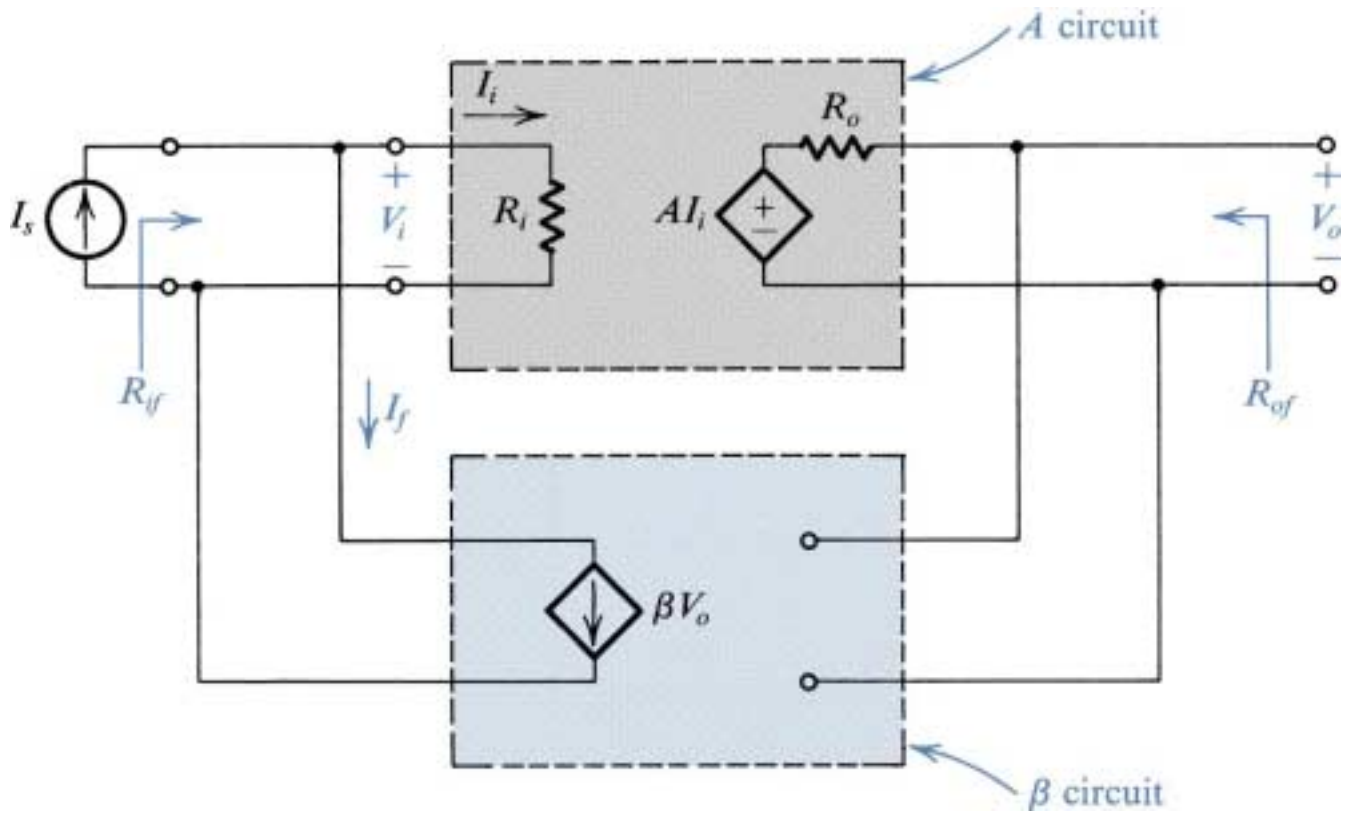
Finding the *A* circuit and β for the current-sampling series-mixing (series-series) case.


$R_{C1} = 9\ \text{k}\Omega$
$R_{C2} = 5\ \text{k}\Omega$
$R_{C3} = 600\ \Omega$
Q_1
Q_2
Q_3
$R_F = 640\ \Omega$
$R_{E1} = 100\ \Omega$
$R_{E2} = 100\ \Omega$
R_{out}
$R_{in} = R_{if}$

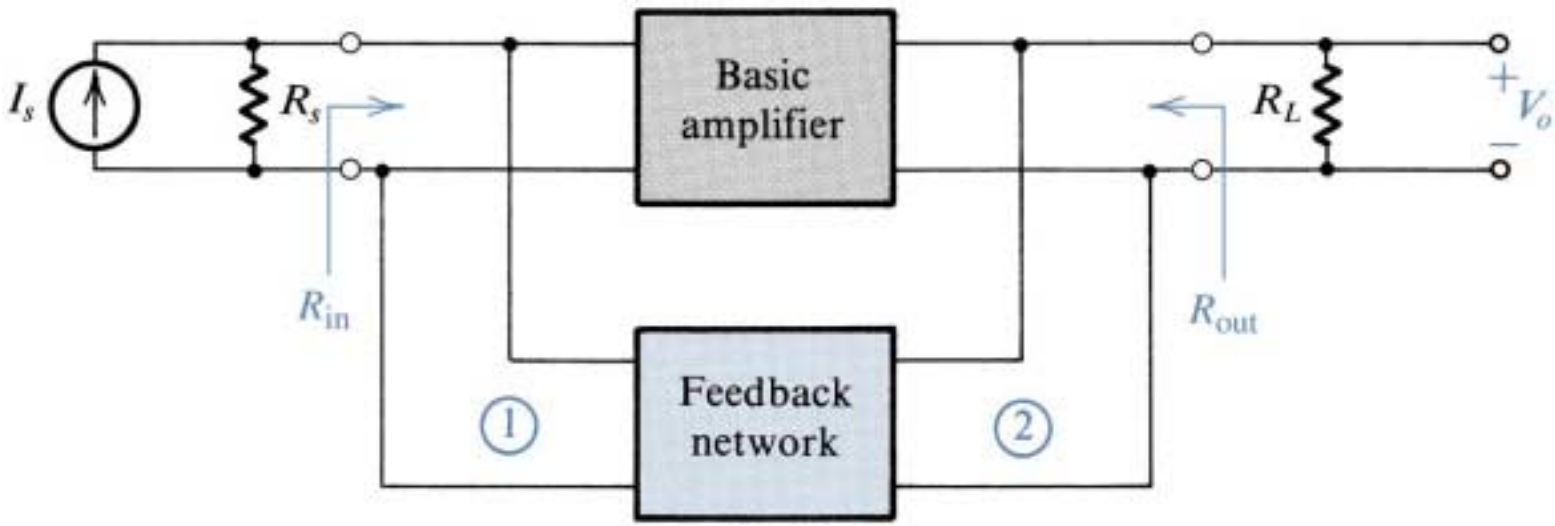

R_{C1}
R_{C2}
R_{C3}
Q_1
Q_2
Q_3
R_F
R_{E1}
R_{E2}
V_i'
R_i
R_o
(b)


R_F
V_f'
R_{E1}
R_{E2}
I_o'

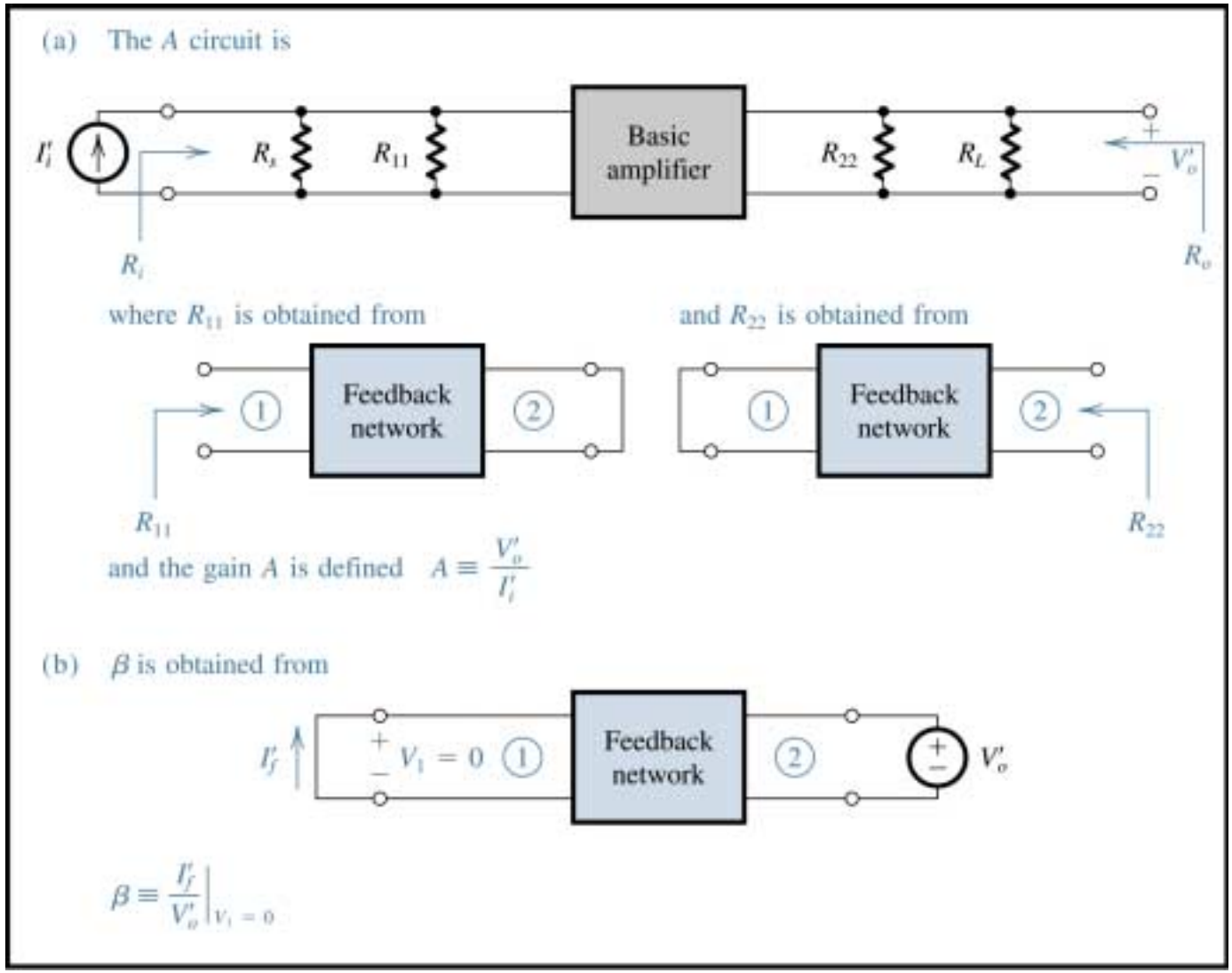

R_{out}
Q_3
R_{of}



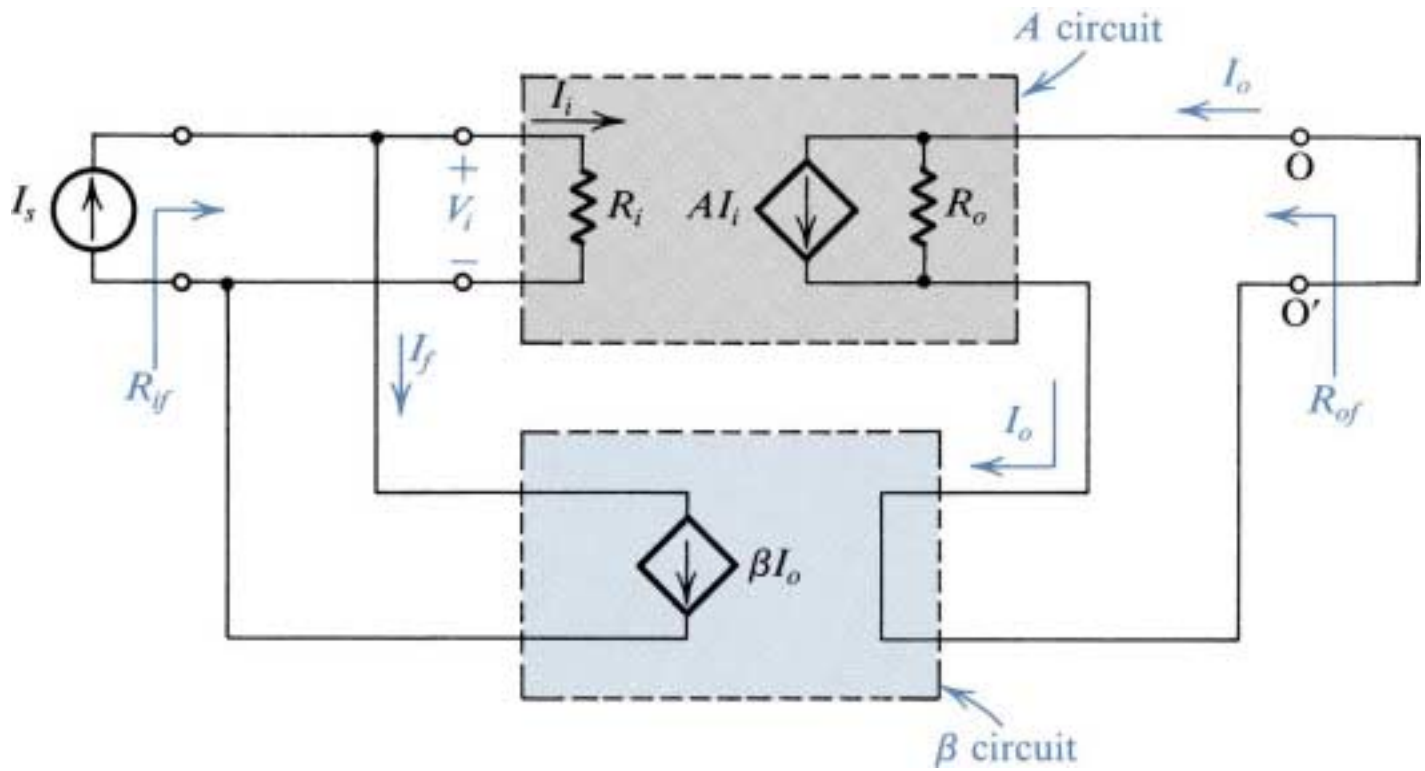
Ideal structure for the shunt-shunt feedback amplifier.



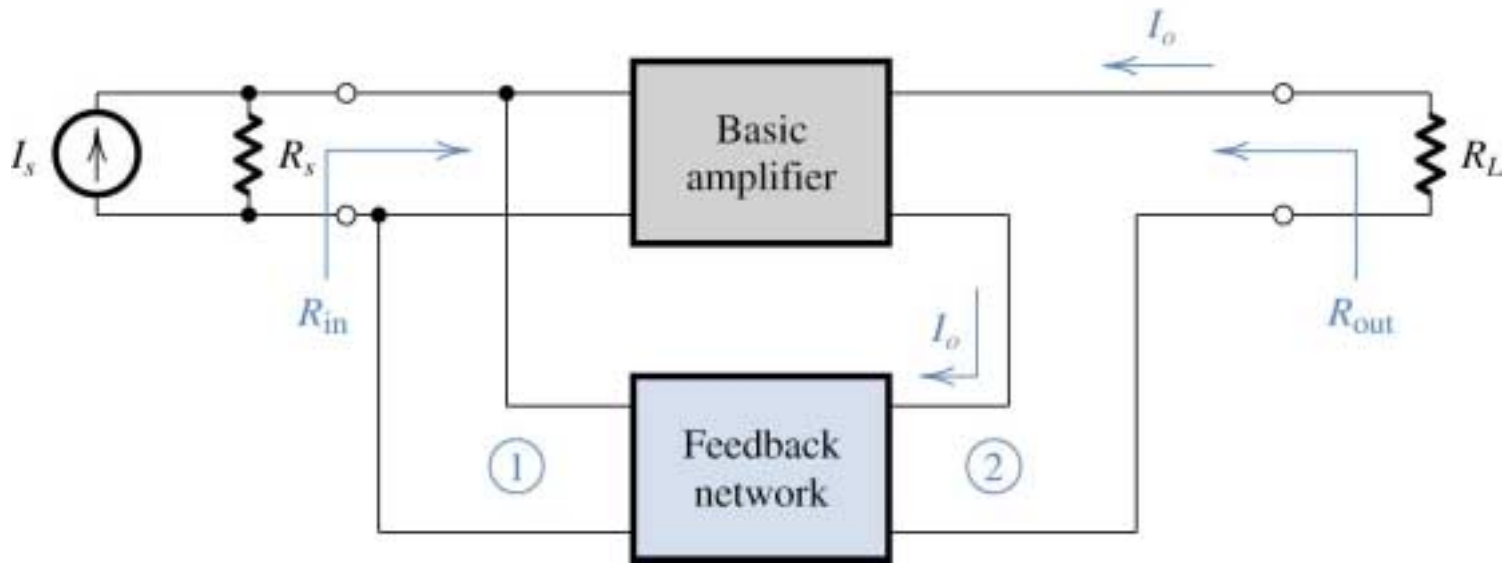
Block diagram for a practical shunt-shunt feedback amplifier.



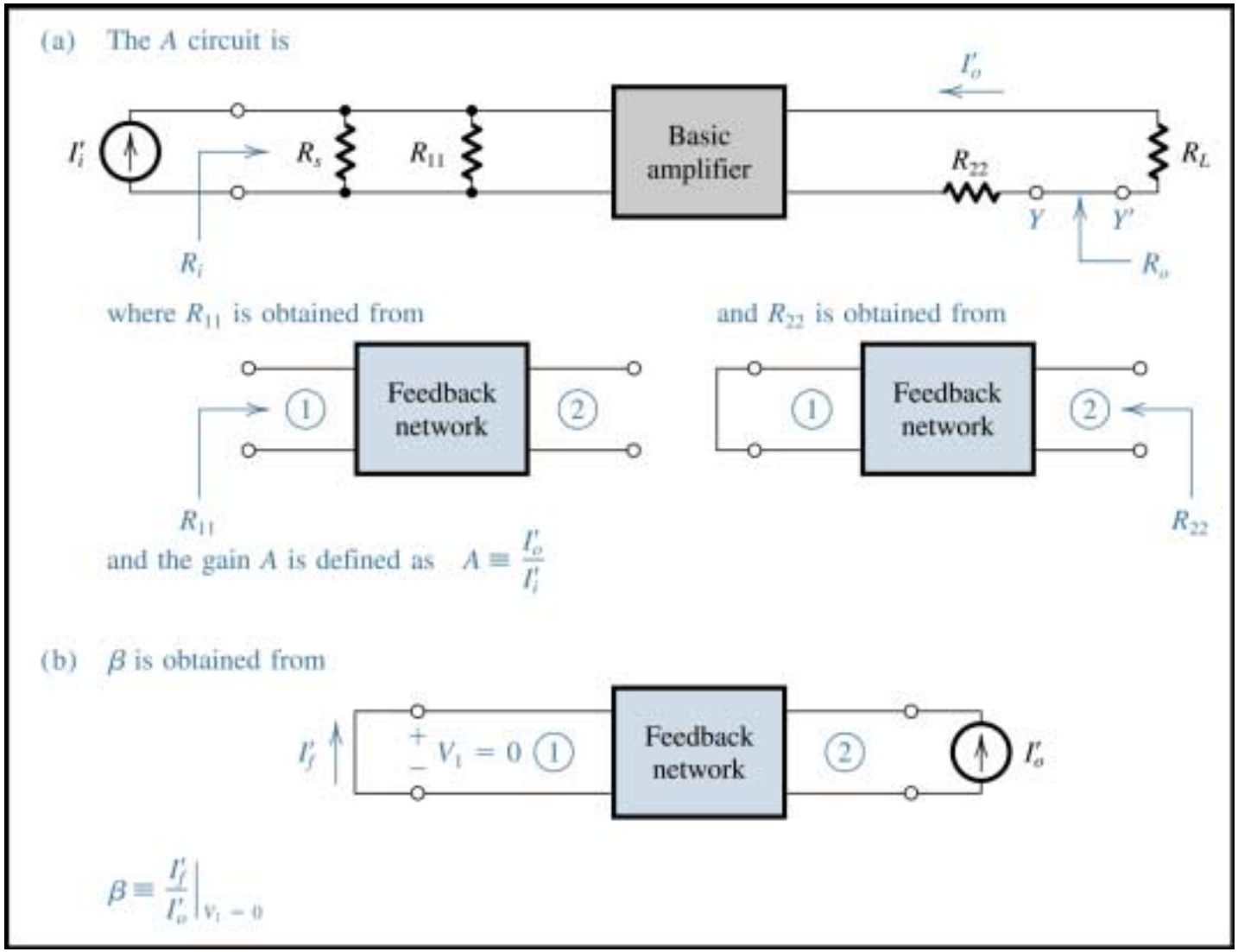
Finding the *A* circuit and β for the voltage-sampling shunt-mixing (shunt-shunt) case.



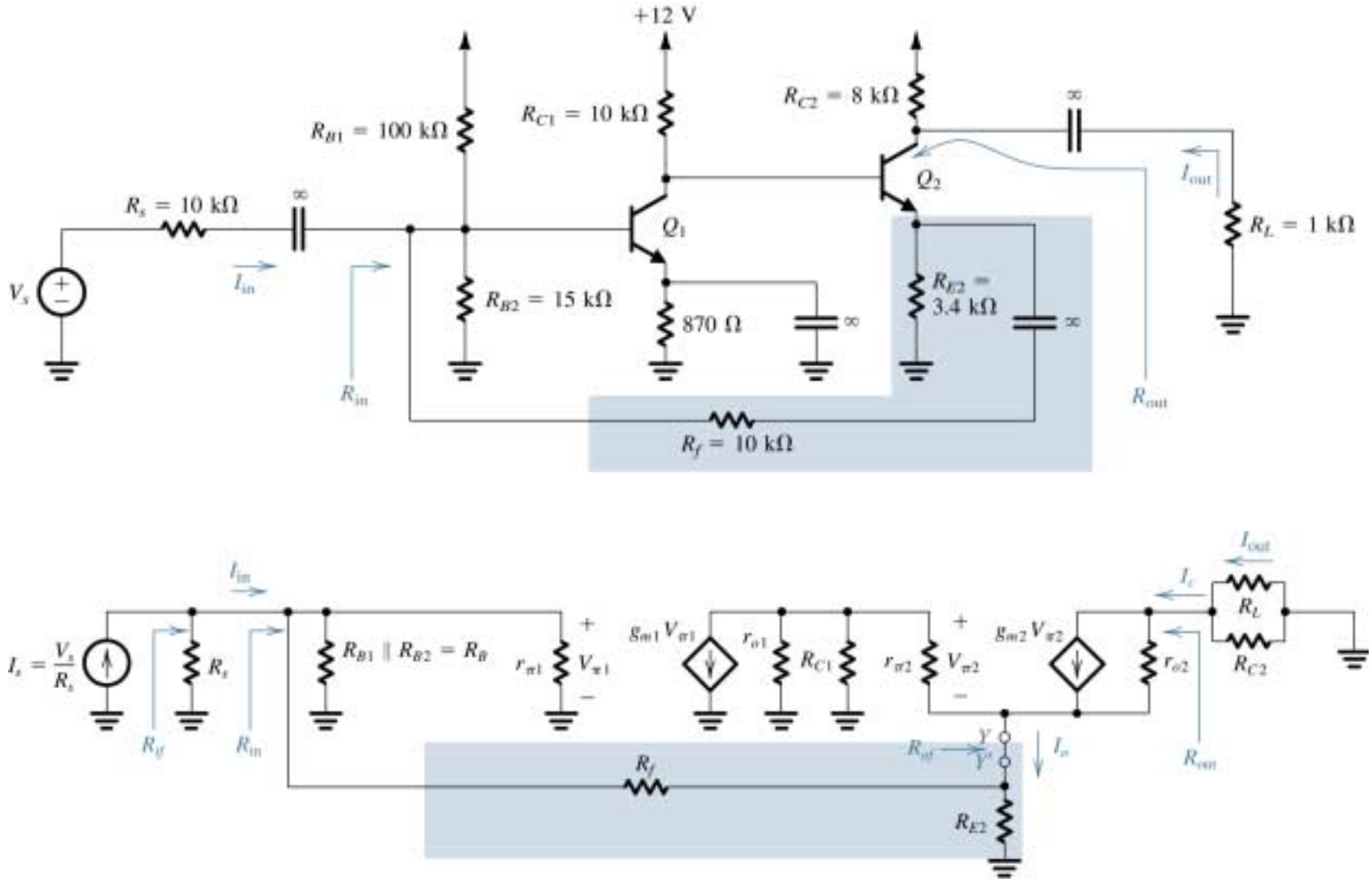
Ideal structure for the shunt-series feedback amplifier.

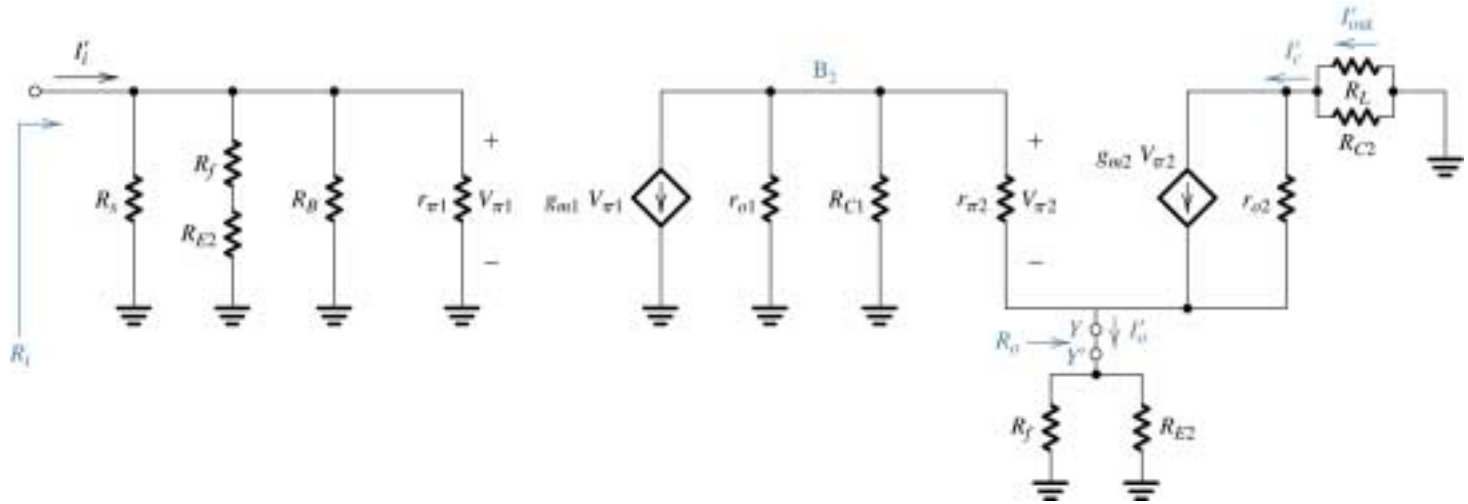


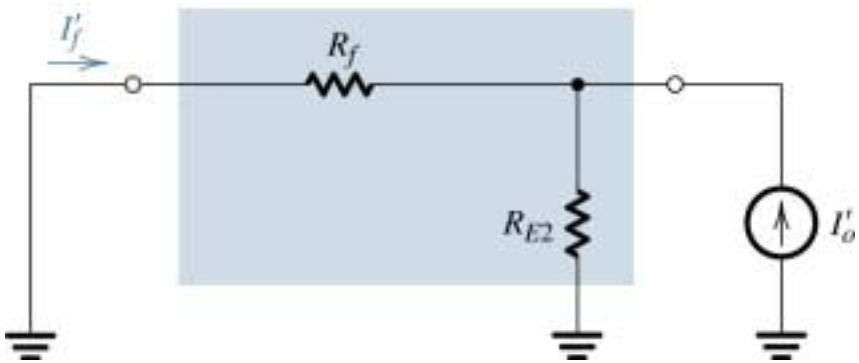
Block diagram for practical shunt-series feedback amplifier

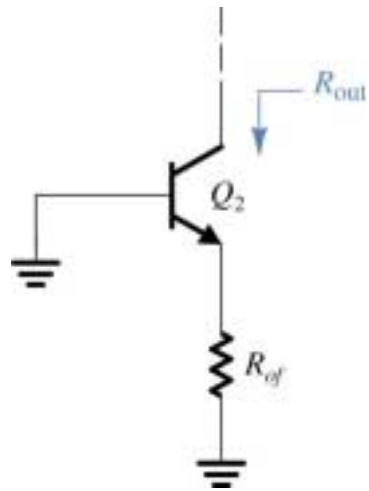


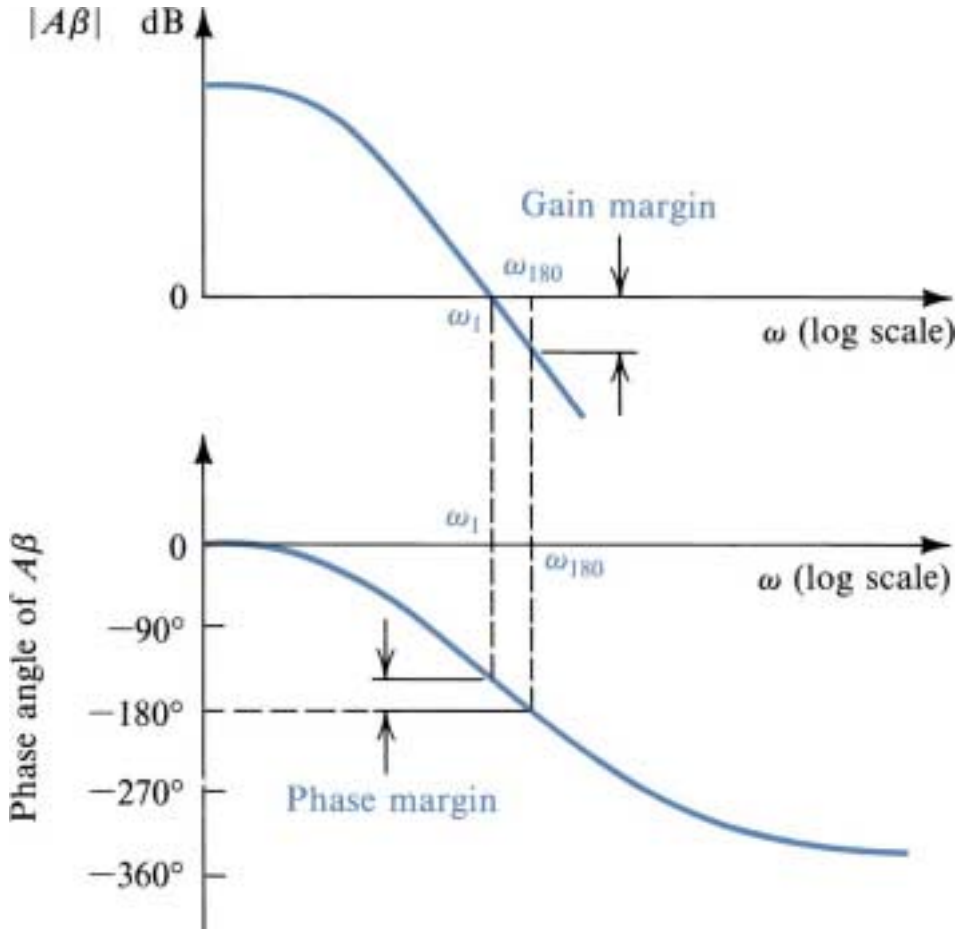
Finding the *A* circuit and β for the current-sampling shunt-mixing (shunt-series) case.


+12 V
R_{B1} = 100 kΩ
R_{C1} = 10 kΩ
R_{C2} = 8 kΩ
R_s = 10 kΩ
Q_1
Q_2
I_{in}
I_{out}
R_{B2} = 15 kΩ
870 Ω
R_{E2} = 3.4 kΩ
R_L = 1 kΩ
V_s
R_{in}
R_{out}
R_f = 10 kΩ
$I_s = \frac{V_s}{R_s}$
R_{if}
$R_{B1} \parallel R_{B2} = R_B$
$r_{\pi 1}$
$V_{\pi 1}$
$g_{m1} V_{\pi 1}$
r_{o1}
$r_{\pi 2}$
$V_{\pi 2}$
$g_{m2} V_{\pi 2}$
r_{o2}
I_o
R_{of}

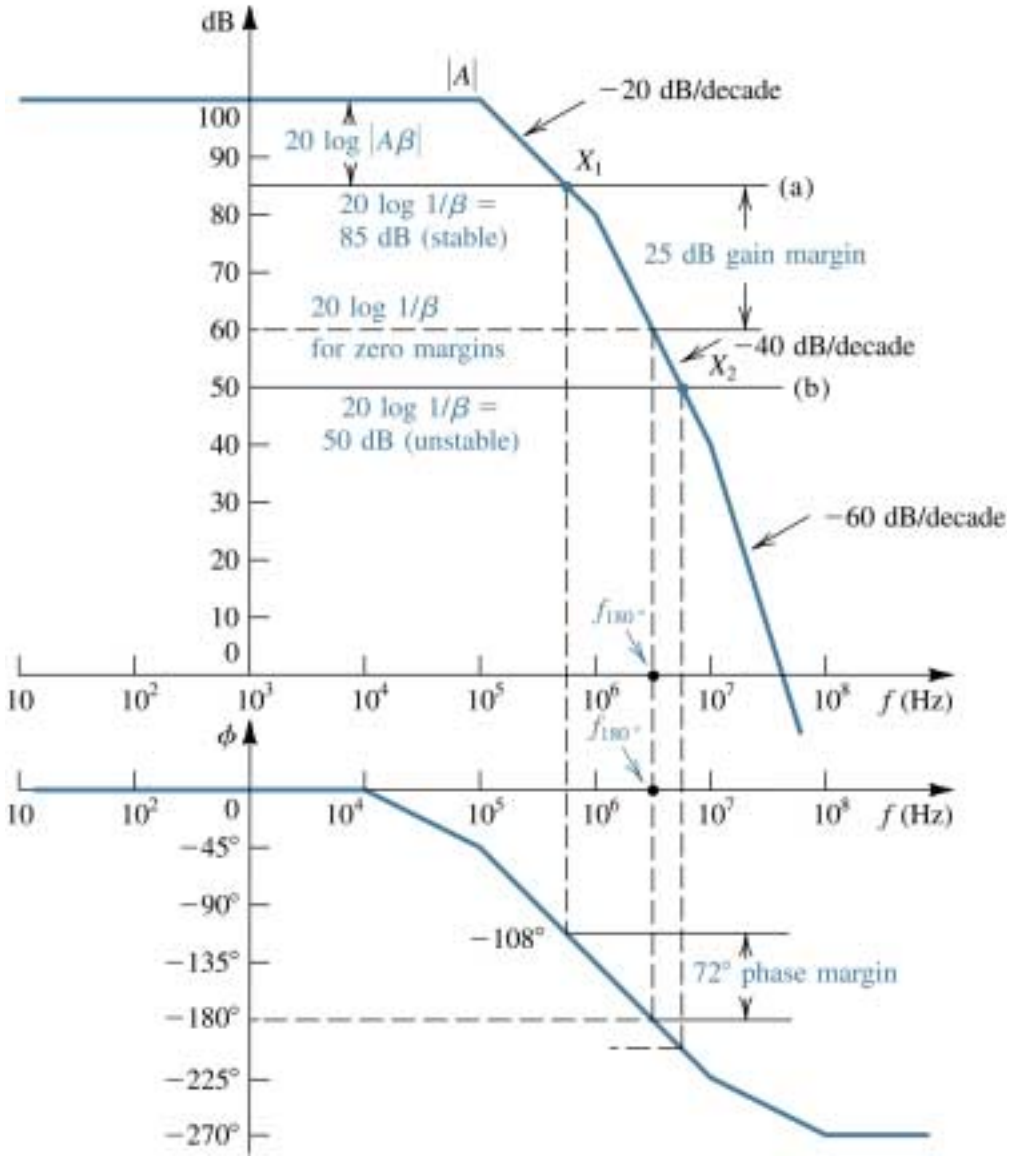

I_i'
R_s
R_f
R_{E2}
R_B
$r_{\pi 1}$
$V_{\pi 1}$
R_i
B_2
$g_{m1} V_{\pi 1}$
r_{o1}
R_{C1}
$r_{\pi 2}$
$V_{\pi 2}$
$g_{m2} V_{\pi 2}$
r_{o2}
I_{out}'
I_c'
R_L
R_{C2}
R_o
V
V'
I_o'
R_f
R_{E2}


I_f'
R_f
R_{E2}
I_o'

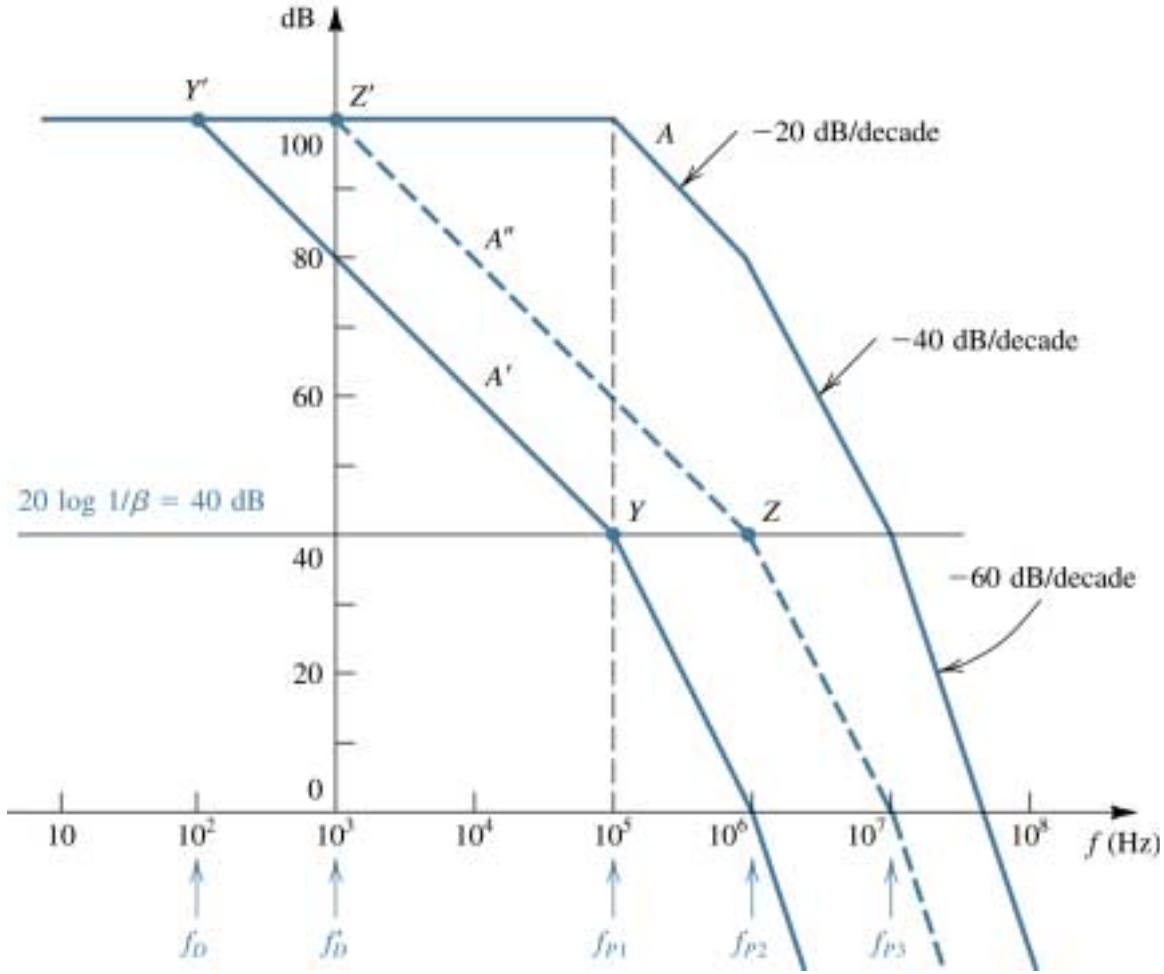

R_{out}
Q_2
R_{of}



Bode plot for the loop gain $A\beta$ illustrating the definitions of the gain and phase margins.



Stability analysis using Bode plot of |A|.



Frequency compensation for $\beta = 10^{-2}$. The response labeled *A'* is obtained by introducing an additional pole at f_D. The *A"* response is obtained by moving the original low-frequency pole to f'_D.

References

- *Electronics* by A. Hambley
- *Microelectronics Circuits* by Sedra & Smith
- Other books on Electronics